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detector Ss1 is corrected with the output of the phase deviation calculator Hs1, and the origin matching is completed at the point D where the phase deviation Hs becomes zero.

FIG. 4 is a view illustrating operation where plural electric motors start their operations from all interruption state and the origin matching is performed during acceleration. Once the operation is started, the contact RYs1 is closed during the acceleration, and a rotational frequency instruction detected by the rotational frequency detector Ss1 is corrected with an output of the phase deviation calculator Hs1, and likewise the origin matching is completed.

FIG. 5 is a view illustrating the operation of the present embodiment wherein there are electric motors in operation and stopped electric motors among plural electric motors, and the stopped electric motors start their operation to be accelerated up to the rotational frequency of the electric motors in operation, and after completion of the acceleration the origin matching is performed. The slave section starting its operation anew is accelerated up to substantially same rotational frequency as that of the section already in operation, and thereafter the origin matching is started at the point A as described previously. The origin matching is achieved with the aid of the action of the aforesaid phase deviation Hs, and the origin matching is completed at the point D where the phase deviation Hs becomes 0.

Although in the present preferred embodiment illustrated in FIG. 1 there was described the situation where the electric motors are provided in the master section, and where there was performed the synchronization control between machine shafts driven by the electric motors and machine shafts driven by the electric motors provided in the slave section, there may be provided in the concentrated controller C means for electronically generating a rotational frequency signal outputted from the incremental encoder Pm and a signal corresponding to the phase signal as described previously, which concentrated controller C may be operated as the master section.

More specifically, signals corresponding to the rotational frequency signal and the phase signal are electronically generated in the concentrated controller C, which signals are in turn provided to the master phase counter Cm1 of the slave section as described in the aforesaid preferred embodiment, whereby the signals corresponding to the rotational frequency signal and the phase signal can be synchronized with the machine shaft of the electric motor of the slave section.

What is claimed is:

1. A synchronization controller including controllers of a master section and at least one slave section, each for controlling an electric motor, said synchronization controller serving to accurately synchronize a rotational frequency and a rotation phase of each said electric motor or a machine shaft driven by each said electric motor, each said slave section controller comprising:

a master rotational frequency detector and a master phase counter for detecting simultaneously at all times a rotational frequency signal and a phase signal from an output of a rotary encoder coupled with the electric motor in the master section or from an output of a rotary encoder coupled with the machine shaft driven by said electric motor, said rotary encoder comprising an incremental encoder with a Z phase pulse, and said master phase counter operating to count the output pulses of said encoder and being cleared with said Z phase pulse;

a slave rotational frequency detector and a slave phase counter for detecting simultaneously at all times a

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rotational frequency signal and a phase signal from an output of a rotary encoder coupled with the electric motor in the slave section or from an output of a rotary encoder coupled with the machine shaft driven by said electric motor, said rotary encoder comprising an incremental encoder with a Z phase pulse and said slave phase counter operating to count the output pulses of said encoder and being cleared with said Z phase pulse; and

a phase deviation calculator for detecting a rotational phase deviation from the outputs of said master phase counter and said slave phase counter at all times, according to counted overflow pulses and the counted output pulses of said master phase counter and said slave phase counter, there being matched an origin of the electric motor in the master section and an origin of the electric motor in the slave section, or matched an origin of the machine shaft driven by the electric motor in the master section and an origin of the machine shaft driven by the electric motor in the slave section to achieve synchronous control.

2. A synchronization controller including a controller of a slave section for controlling an electric motor, said synchronization controller serving to accurately synchronize a rotational frequency and rotation phase of said electric motor or a machine shaft driven by said electric motor with a rotational frequency signal pulses and a Z phase pulse signal electronically generated within and outputted from a master section, said slave section controller comprising:

a master rotational frequency detector and a master phase counter for simultaneously detecting the rotational frequency signal and the phase signal from an output of an incremental encoder with a Z phase pulse coupled with the electric motor in the master section or from an output of a rotary encoder coupled with the machine shaft driven by said electric motor outputted from the master section at all times, and said master phase counter operating to count the output signal pulses from said master section and being cleared with the Z phase pulse from said master section;

a slave rotational frequency detector and a slave phase counter for detecting simultaneously at all times the rotational frequency signal and the phase signal from an output of an incremental encoder with a Z phase pulse coupled with the electric motor of the slave section or from an output of an incremental encoder with a Z phase pulse coupled with the machine shaft driven by the electric motor, and said slave phase counter operating to count the output pulses of said encoder and being cleared with said Z phase pulse; and

a phase deviation calculator for detecting a rotational phase deviation from the outputs of said master phase counter and said slave phase counter at all times, according to counted overflow pulses and the counted output pulses of said master phase counter and said slave phase counter, there being matched an origin of said electric motor of the slave section or the machine shaft driven by said electric motor based upon the phase deviation detected by said phase deviation calculator to synchronize rotation phase of said electric motor or the machine shaft driven by said electric motor with the signal outputted from the master section.

3. A synchronization control method including a plurality of electric motors, each for driving at least one rotating machine shaft and a controller for a master section and at least one slave section, each said controller for controlling

one of said electric motors, said synchronization control method serving to accurately synchronize a rotational frequency and rotation phase of each said electric motor or the machine shaft driven by each said electric motor, comprising the steps of:

when all of said electric motors start their operations from a stopped state, simultaneously detecting at all times a rotational frequency signal and a phase signal from an output of an incremental rotary encoder with a Z phase pulse coupled with the electric motor in the master section or of a machine shaft driven by said electric motor and further simultaneously detecting at all times a rotational frequency signal and a phase signal from an output of an incremental rotary encoder with a Z phase pulse coupled with of the electric motor of in the slave section or of the machine shaft driven by the said electric motor;

calculating a rotational phase deviation from said rotational frequency signal and said phase signal according to counted overflow pulses and counted output pulses of a master phase counter and a slave phase counter; and

matching origins of said electric motors of in each slave section or of the machine shafts driven by said electric motors based upon said phase deviation during acceleration of all number of the electric motors or after all number of said electric motors reach a predetermined rotational frequency, and synchronizing the rotation phase of said electric motors or of the machine shafts driven by said electric motors with the phase signal outputted from the master section.

4. A synchronization control method including a plurality of electric motors, each for driving at least one rotating machine shaft and a controller for each of a master section and a slave section, each controller for controlling one of

said electric motors, said synchronization control method serving to accurately synchronize a rotational frequency and rotation phase of each said electric motor or the machine shaft driven by each said electric motor, comprising the steps of:

when some of said electric motors are in operation and others of said electric motors are under interruption and the operation of the electric motors under interruption is started, simultaneously detecting rotational frequency signals and phase signals from an output of an incremental rotary encoder with a Z phase pulse coupled with the electric motor in the master section or the machine shaft driven by said electric motor at all times and further simultaneously detecting the rotational frequency signals and the phase signals from an output of an incremental rotary encoder with a Z phase pulse coupled with the electric motor in each slave section or of the machine shaft driven by each said electric motor at all times;

calculating a rotational phase deviation from said rotational frequency signals and said phase signals according to counted overflow pulses and counted output pulses of a master phase counter and a slave phase counter; and

matching origins of said electric motors in each slave section or of the machine shafts driven by said electric motors based upon said phase deviation after said electric motors reach a predetermined rotational frequency to synchronize the rotation phase of said electric motors or of the machine shafts driven by said electric motors with the phase signal outputted from the master section.

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